Worker Earnings, Service Quality, and Firm Profitability: Evidence from Nursing Homes and Minimum Wage Reforms

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Abstract

This paper examines whether higher earnings for frontline workers affects the quality of employees' output. I leverage increases in the statutory minimum wage, combined with worker, consumer, and firm outcomes in the nursing home sector. I find that higher minimum wages increase income and retention among low-wage employees and improve consumer outcomes, measured by fewer inspection violations; lower rates of adverse, preventable health conditions; and lower resident mortality. Firms maintain profitability by attracting consumers with a greater ability to pay and increasing prices for these individuals. *JEL codes: J38, J3, I18*

[*]I thank Hilary Hoynes, David Card, Nora Gordon, Giulia Giupponi, Natalie Holmes, Seema Jayachandran, Elizabeth Linos, Jordan Matsudaira, Brendan Price, Michael Reich, Jesse Rothstein, Sally Stearns, Matthew Unrath, Christopher Walters, Abbie Wozniak, and Danny Yagan for helpful discussions and feedback. This paper benefited from participant comments at UC-Berkeley; UC-Davis; Penn State; the University of Kentucky; the Upjohn Institute; the Minneapolis Federal Reserve; the University of Georgia; Georgia State University; Georgetown University; Vanderbilt University; the Furman Center; Chicago Urban Labs; the UC Child Health, Poverty, and Public Policy Summer School; and the All-California Labor Economics, American Society of Health Economists, Society of Labor Economics, and Washington Area Labor Economics Symposium conferences. The Washington Center for Equitable Growth provided generous financial support and Jess Belledonne, Chukwuma Okoro, and Ilya Schneider provided excellent research assistance.

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1 Introduction

The quality of goods and services affects consumer well-being, but in many settings, employers and customers cannot discern quality at the time of production or purchase. In these situations, paying frontline workers higher wages can incentivize higher quality (Shapiro and Stiglitz, 1984; Akerlof, 1982; Lazear and Moore, 1984). Beyond standard efficiency wage considerations, increasing pay for low-wage workers may reduce stress and improve decision-making (Mani et al., 2013). Additionally, if higher wages reduce worker turnover, increases in job-specific expertise can improve production efficiency.

Although efficiency wage and human capital theories are well developed, the existing empirical work examining compensation and worker performance focuses on production industries, where quality is readily observable. In contrast, there is little evidence whether higher pay affects consumer outcomes in service industries where employee effort is difficult to monitor and quality is not easily quantified. Moreover, the relationship between mandatory wage floors stipulated by government policy and worker performance is *a priori* ambiguous. While minimum wages could improve quality by attracting more productive workers or incentivizing greater effort, quality may worsen if employers instead reduce staffing.

This paper broadens our understanding of how employee compensation translates into consumer well-being by examining the relationship between workers' wages and patient outcomes in long-term residential care settings. I leverage exogenous wage increases for healthcare support staff driven by 25 years of minimum wage reforms with objective health and safety measures for the near universe of nursing home facilities. This setting enables an extension of the cross-border county-pair two-way fixed effects (CBCP-TWFE) empirical framework pioneered by Card and Krueger (1994) and generalized by Dube et al. (2010) and Dube et al. (2016) by examining outcomes at the establishment level and including reforms that vary across states, counties, cities, and establishments. Accordingly, this approach compares changes in patient well-being within a facility relative to neighboring firms before and after a wage change while flexibly accounting for other local changes at granular geographic levels. I document that facilities in adjacent counties have more similar economic and de-

mographic characteristics and trends than facilities in non-adjacent counties, which provides support for the CBCP-TWFE approach over a more parsimonious design that leverages national comparisons over all facilities. Further support for the empirical design is illustrated in event study analyses, which show a similar evolution of staffing patterns, resident health, and resident demographic characteristics in the years leading up to a reform.

I first establish higher minimum wages increase earnings among low-wage healthcare workers: a 10% minimum wage increase raises nursing assistant earnings 1.1-2.0% without significantly reducing employment. Although there is little existing work on nursing homes in the U.S. minimum wage literature, the earnings and employment responses are comparable to those in other industries (Dube et al., 2010, 2016; Jardim et al., 2017; Cengiz et al., 2019). I also find higher minimum wages increase tenure by reducing separations and increasing the share of new employees who are retained for at least 3 months, again consistent with work in other sectors (Dube et al., 2016; Portugal and Cardoso, 2006; Brochu and Green, 2013).

Second, I provide some of the first empirical evidence how higher employee wages can improve consumer well-being. I find a 10% minimum wage increase reduces the number of health inspection violations by 2% (0.1 violation for the typical facility each inspection), the fraction of residents with moderate-to-severe pressure ulcers by 1.7% (0.14 percentage points), and nursing home mortality by 3.1-3.2% (about 15,000 deaths a year). In addition, event study analyses illustrate the improvements in costly health outcomes (pressure ulcers and mortality) persist for several quarters.

Third, I examine how employers offset higher labor costs and document that the mechanical wage increase for low-paid staff fully accounts for facilities' reported cost changes: there is no substitution towards credentialed nurses or other factors of production. Instead, facilities increase revenue in two ways: first, by increasingly serving clients with a greater ability to pay (those paying out of pocket rather than Medicaid recipients), and second, by charging private payors higher prices. As the additional labor costs caused by higher wages are a small share of facilities' total operating budget, changes on each of these margins is relatively minor on an individual level. For example, a 10% minimum wage increase would

lead an average 100-bed facility to serve 0.3 fewer Medicaid recipients and would charge private payors about $5.90 (2.2%) more each day.

These findings are consistent with minimum wages improving consumer well-being through increasing firm-specific experience and improving worker performance; however, the motivation for efficiency wages – that higher compensation improves worker productivity when effort is *imperfectly observable* – presents a challenge for disentangling potential mechanisms. In the absence of a direct measure of worker productivity, I rule out several competing explanations. First, although residents become more positively selected following minimum wage increases, changes in observable patient characteristics cannot account for most of the health improvements. Second, findings are not driven by low-performing firms exiting the market. Third, there is no evidence these improvements are due to changes in the workforce, as staff demographic characteristics do not change and credentialed nurse employment does not increase. Combined, these results are consistent with higher minimum wages inducing better performance among current workers and increasing firm-specific human capital.

These findings provide some of the first empirical evidence on how higher wages can improve service quality in low-wage settings. The nursing home industry is an important setting to explore this relationship for several reasons. First, long-term care is a large and growing sector, accounting for about 10% of Medicaid and Medicare expenditures. Patients have imperfect information about the quality of care at the time of admission, as health conditions develop over time and require expertise to diagnose. In addition, stakeholders have expressed concerns about the quality of care for at least 60 years (Castle and Ferguson, 2010; Institute of Medicine, 1986) and the federal government has responded in part by requiring routine inspections and patient assessments. The data from these requirements provide objective staffing, health inspection, and health measures that are comparable across facilities and cover the near universe of nursing homes from 1991 through 2017.

This paper makes several contributions to the existing literature. First, an extensive literature finds that higher statutory minimum wages increase earnings, with a typical earnings elasticity for affected groups of approximately 0.2 (for summaries, see CBO, 2019, Wascher

and Neumark (2007), and Schmitt (2013)). Employment effects center on zero (Belman and Wolfson, 2014; Doucouliagos and Stanley, 2009) but vary across specifications – especially with the use of geographic controls (Card and Krueger, 1994; Dube et al., 2010, 2016; Allegretto et al., 2017; Neumark and Wascher, 1992; Neumark et al., 2014), the population studied, and the time period examined (Cengiz et al., 2019). The previous research focuses on the retail and food services industries, and I extend the literature by focusing on a different setting (low-wage healthcare support) and a time period with substate minimum wage variation. Consistent with much of the previous work, results indicate modest minimum wage increases raise low-wage workers' earnings without significantly reducing employment.

Second, a smaller literature examines the effects of minimum wages on consumer well-being. Existing work focuses on consumer prices (Draca et al., 2011; Harasztosi and Lindner, 2019; Aaronson et al., 2008; Allegretto and Reich, 2018), and this paper provides some of the first empirical evidence of how higher minimum wages affects consumer well-being on non-financial dimensions. One notable exception is Giupponi and Machin (2018), who examine a single national minimum wage reform in the UK and find higher minimum wages increase the number of nursing home inspection violations. An important difference is that British nursing homes have limited ability to increase prices, whereas in the US, some of the largest improvements occur in facilities that are located in states where Medicaid reimbursement incorporates staffing costs, namely the facilities that are most able to adjust revenue in response to higher wages. More generally, my findings are consistent with work showing that higher public-sector wages improve service quality, measured by hospital deaths in the context of hospital employees (Propper and Van Reenen, 2010) and student test scores for teachers (Britton and Propper, 2016).

Third, this paper relates to personnel policies in the long-term care sector. The previous work in this area finds that increased staffing due to changes in regulations and macroeconomic conditions reduces mortality and the number of inspection violations (Chen and Grabowski, 2015; Matsudaira, 2014; Park and Stearns, 2009; Antwi and Bowblis, 2018; Stevens et al., 2015) but has mixed effects on other measures of patient health (Matsudaira,

2014; Chen and Grabowski, 2015; Bowblis, 2011; Park and Stearns, 2009). Other work finds unionization decreases staffing levels without worsening patient outcomes, indicating labor market policies can alter worker productivity (Sojourner et al., 2015). Greater revenue driven by reimbursement policies also benefits patients by increasing skilled nursing care (Hackmann, 2019). This paper complements the existing literature by examining a policy – minimum wages – that has not been fully explored in previous work. While Cawley et al. (2006) find that higher minimum wages reduce physical restraints and increase psychotropic medications, my analyses leverage minimum wage variation within narrow geographic areas over a longer time horizon. Compared to similarly-priced staffing requirements, higher wages generate improvements at least as large, and these wage policies confer benefits net of existing regulations and economic conditions.

The remainder of this paper proceeds as follows. Section 2 describes the nursing home industry. Section 3 overviews the data and cross-county border pair empirical approach, with the Appendix providing greater detail. Section 4 presents results for workers, consumers, and firms, and Section 5 concludes. Supplemental appendices provide additional results.

2 Institutional setting: Nursing homes

Approximately 1.4 million residents receive around-the-clock nursing care in about 15,600 nursing homes (also called nursing facilities).[1] Most residents are elderly and require assistance with activities of daily living (ADL), such as eating, bathing, dressing, mobility, and toileting. Most facilities operate at or near capacity, but the supply of nursing home services is relatively inelastic at both the facility and aggregate level as most states restrict construction and limit the number of beds in each facility (HHS, 2015).[2]

[1] Approximately 92% of certified nursing facilities are dually certified as skilled nursing facilities (SNF) (HHS, 2015) and are able to receive both Medicaid and Medicare reimbursement. Medicare covers up to 100 days of SNF care after hospital discharge.

[2] In 2016, the median occupancy rate was 85%, and 15% of facilities exceeded 95% capacity. Due to intake processes and limits on discharging residents many facilities would reach capacity if they accepted all applicants (Gandhi, 2020).

Government insurance programs finance most nursing home stays: 62% of residents have Medicaid and 14% have Medicare coverage. Reimbursement rates for both Medicaid and Medicare are set by expected patient costs, with Medicare rates determined by each resident's service needs and a local cost-of-living adjustment and Medicaid rates set by state-specific payment structures. The remaining residents (private payors) who pay out of pocket incur costs at market rates – typically about 30% more than Medicaid rates (Appendix Table A1) – may be especially beneficial for firms' revenue (Gertler, 1989).

Nursing homes are labor-intensive enterprises. About 40% of the industry's 1.6 million employees work in healthcare support roles as nursing assistants. Nursing assistants' duties – such as recording vital signs, monitoring health, administering medical treatments, assisting with ADLs, and building relationships with patients – directly affect patient health and longevity (ONET, 2018). The typical healthcare support worker in the long-term care industry received about $13 an hour at the end of the analysis period, a wage comparable to that in other low-pay sectors (BLS, 2019). Turnover is also high in this industry: at least 62% of nursing assistants change employers each year, with most job transitions occurring among nursing homes (Berridge et al., 2018; Gandhi et al., 2021).

Appendix Table A2 situates nursing homes in the minimum wage literature by comparing wages and demographic characteristics of nursing staff with those of food service and retail workers. Nursing assistants earn higher wages than restaurant workers but amounts similar to those of retail workers, while licensed nursing staff – LPNs and RNs – are paid more than the typical private sector worker. Therefore, while minimum wage increases likely only affect the labor market for nursing assistants, changes in LPN and RN employment provide placebo tests to ensure the empirical design is not simply capturing economy-wide wage increases.[3]

3 Data and empirical framework

[3]Workers affected by a 10% minimum wage increase are calculated as the fraction of workers up to 115% of the new minimum (Dube et al., 2019).

3.1 Data: Worker earnings and employment

Several datasets provide information on how minimum wages affect nursing home employment, earnings, and turnover. First, the Centers for Medicare and Medicaid (CMS) Online Survey Certification and Reporting and Certification and Survey Provider Enhanced Reporting (OSCAR/CASPER) system report staffing in full-time-equivalent workers (1991-2017) and hours per resident per day (2000-2016) by occupation in each facility on an annual basis. Second, the California Office of Statewide Healthcare Planning and Development (OSHPD) data includes annual payroll and turnover by occupation for all California facilities for years 2003-2017. I supplement this facility-level information with quarterly county-level data on employment, earnings, and turnover from the Quarterly Workforce Indicators (QWI). Since low-wage nursing home staff are overwhelmingly female and have low levels of educational attainment (Appendix Table A2), the QWI analyses focus on female employees with no more than a high school education working in nursing home facilities.

Additional earnings information comes from household surveys, the Current Population Survey Outgoing Rotation Group (CPS-ORG) for years 1991-2017 and American Community Survey (ACS) for years 2000-2017. Both datasets include demographic, industry, and occupation information. The CPS-ORG data reports the state of residence and some counties and metropolitan areas on a monthly basis, whereas the ACS data provide respondents' Public-Use Microdata Area (PUMA) residence on an annual basis.

3.2 Data: Resident safety and health outcomes

Long-standing concern about the quality of care provided in nursing home settings has resulted in federally-required annual health inspections and quarterly patient assessments (Castle and Ferguson, 2010; Institute of Medicine, 1986). Both inspection and assessment information are published by CMS as part of the Nursing Home Compare (NHC) database.

Health inspection violations and resident safety: Independent state staff conduct unannounced annual health inspections at each nursing home. These inspections involve facility observations and interviews with staff, patients, and families to determine the quality and frequency of care. Facilities that perform poorly on inspections are subject to fines and

denials of payment until the issues are corrected, and may be forced to close in the most extreme cases. These penalties therefore provide a minimum quality threshold that firms must satisfy in order to operate.

Inspection violations are common in nursing homes: nearly all (96%) facilities have at least 1 violation each year, and the typical facility has 5. Yet most citations are not considered severe, only 1/3 represent high-risk conditions that actively endanger or harm residents. The NHC data report the type, severity, and scope of each violation a facility has received since 1998, as well as the inspection date.[4] I focus on the subset of violations most closely associated with nursing responsibilities (Chen and Grabowski, 2015; Harrington et al., 2000; Matsudaira, 2014; Antwi and Bowblis, 2018).[5] For these "quality of care" violations, I examine the number of violations; the number of severe violations; and an index incorporating the number, severity, and scope of such violations.[6]

Resident health: Nursing homes report resident health conditions to CMS each quarter that are published in the NHC data. These Quality Measures (QM) include several conditions that are related to nursing care, including pressure ulcers (pressure sores or bed sores), urinary tract infections (UTIs), physical restraints, and psychotropic medications.[7] Additional resident information, such as demographics, payment source, and care needs, is derived from the Minimum Data Set and reported annually for each facility through LTCFocus.

Mortality: Health inspections and patient health provide measures of customer well-being, but both have shortcomings: inspections are prone to inspector oversight and health

[4]The Data Appendix provides narrative excerpts that illustrate the nature of the inspection process and the environments that trigger violations.

[5]"Quality of care" violations include assessment, quality of care, nursing, dietary, physician, rehabilitative services, dental, and pharmacy infractions (Harrington et al., 2000).

[6]The index for facility f at time t adds the scope/severity points for each violation v_{ft} with severity, sev, and scope sc: $v_{ft} = \sum_{sc \in SC} \sum_{sev \in SEV} v_{sc,sev,f,t}$ and standardizes by $z_{fy} = \frac{v_{fy} - \overline{v}}{\sigma_{\overline{v}}}$ where $\overline{v}$ is the grand mean and $\sigma_{\overline{v}}$ is the corresponding standard deviation.

[7]The assessment data covers the 2005-17 period for all outcomes except for psychotropic medications (which were introduced in 2011) in order to minimize definitional changes.

conditions are reported by facility employees. Mortality, in contrast, is well measured and not subject to these concerns. In addition, mortality is relatively high among nursing home residents: about 1/3 die within a year of admittance, 3 times the rate for the population ages 85 and older (Flacker and Kiely, 2003). I calculate quarterly county age-adjusted nursing home death rates with data from Vital Statistics microdata, which includes each individual's age and place of death.[8]

3.3 Data: Facility profits

Nursing facilities that serve Medicare recipients are required to submit annual financial data to CMS.[9] These data include annual reported total costs, per-resident revenue, Medicare care needs (a measure of Medicare reimbursement), and total net income for years 1996-2017.

3.4 Empirical framework

Minimum wage changes are regionally clustered, with higher minimums concentrated in western and northeast states, and more recently urban areas. Standard two-way fixed effects (TWFE) approaches that estimate the effect of higher minimum wages with state and time fixed effects require that changes in the minimum wage are uncorrelated with outcomes – in this setting, nursing home staffing and resident health – in all counties across the country. Over the analysis period, however, both employment growth and the elderly population – potential nursing home clients – have varied substantially across regions. For example, between 1991-2017, employment grew more than 12% in Nevada, but increased by less than 10% in states like West Virginia and New York. Over the same period, the elderly population more than doubled in states like Arizona and Nevada, but increased by less than 30% in

[8]The age adjustment accounts for the aging of the population over the analysis period and is given by $m_{ct} = \sum_{a=65}^{85+} \frac{deaths_{cat}}{pop_{cat}} * \frac{pop_{a,jul2000}}{\sum_{k=65}^{85+} pop_{k,jul2000}}$ where $deaths_{cat}$ is the number of deaths in nursing homes in county c among those aged a in quarter t. pop_{cat} is the number of individuals aged a in each county. The second term is the national fraction of individuals age a in July 2000, top-coded at age 85 in the population data.

[9]These data are available only for Medicare-certified SNFs, and facilities that serve few Medicare patients may submit an abbreviated form that does not include all information.

states like Iowa and North Dakota. The standard TWFE approach with state and year fixed effects does not fully account for this regional heterogeneity.

Within smaller geographical areas, employment, aging, and nursing home characteristics are more similar but there is still substantial variation in the minimum wage due to reforms at the state — and more recently substate — level. This variation in minimum wages within narrow geographic areas permits an extension of the standard TWFE approach that limits comparisons to facilities in two neighboring counties in a cross-border, "county pairs" two-way fixed effects (CBCP-TWFE) design. Intuitively, the CBCP-TWFE approach examines changes in patient outcomes within a facility that experienced a minimum wage increase to changes in facilities in a neighboring county that did not experience such an increase. This approach, pioneered by Card and Krueger (1994) and generalized by Dube et al. (2010) and Dube et al. (2016), incorporates county pair-specific time fixed effects, which flexibly captures changes in local economic, population, and unobservable patterns that pertain to both counties within a pair without functional form assumptions. Accordingly, the CBCP-TWFE design is less likely to conflate broader regional differences in employment and an aging population with changes in the minimum wage.

The CBCP sample includes the subset of establishments where a neighboring jurisdiction faced a different minimum wage at any point over the analysis period, including facilities in two states that straddle a state border (Illinois and Indiana), a county border within a state (Cook and DuPage County, IL), and cities bordering a county with a different minimum (Seattle and adjacent Snohomish County).[10] Importantly, minimum wages vary within narrow geographic areas due to federal, state, county, or city action and this spatial variation has increased over time.[11] Figure 1 maps the geographic variation from 2002-17, with darker shades corresponding to larger cross-border gaps. In the late 1990s and early 2000s, minimum wage variation was concentrated on the east and west coasts; by the 2010s, approximately

[10]County borders are coterminous with state lines: no county is located in multiple states.

[11]Federal contractors are subject to a $10.10 minimum wage as of 2015. Matching facility addresses to procurement data identifies about 4% of facilities as contractors.

1/3 of nursing home patients lived in a facility where an adjacent county had a different minimum wage, including some in the Midwest and the South (Appendix Figure A1). In total, the county pairs sample includes approximately 7,700 facilities in 1,136 counties that experienced an average of 7 minimum wage reforms between 1990-2017.[12]

Table 1 empirically tests how differences in economic, demographic, and nursing home characteristics compare between the full national sample and the county pairs sample in levels and trends. For each covariate, I calculate the mean absolute difference between facilities in each county, c_1, and a randomly-selected non-adjacent county in a different state, $-c$, and report these differences in in levels (column 1) and long-differences (columns 5 and 9). The corresponding mean absolute difference for the county pair sample – between facilities in county c_1 and neighboring county c_2 – is reported in columns 2, 6, and 10. Columns 3, 7, and 11 report the difference between the non-adjacent and county-pair samples, scaled by the gap in the county pair difference in columns 4, 8, and 12.

For all covariates in levels and changes, the within-county-pair difference in columns 2, 6, and 10 is smaller than the non-contiguous gap, illustrating that facilities in neighboring jurisdictions have more comparable economic, demographic, and facility characteristics that evolve more similarly than those in non-neighboring counties. These patterns support favoring the CBCP-TWFE approach over a simpler TWFE design. Nonetheless, even though the gaps within the county pairs sample are attenuated, significant differences continue to exist. Therefore, in order to further account for differences in economic conditions and the composition of the elderly population, my preferred specifications control for time-varying resident demographics, economic conditions, and local policies targeted to low-wage workers. Moreover, event study analyses provide a separate exercise that supports the validity of the CBCP-TWFE approach in a more flexible framework by indicating that resident characteristics and health outcomes are not differentially trending in treatment and control counties

[12]Appendix Table A3 shows the county pair sample is similar to the full universe of nursing homes in staffing levels per resident, resident demographic characteristics, number and severity of inspection violations, and patient outcomes.

within a county pair before a minimum wage increase (Appendix Figure A6).

With the CBCP sample, I examine how minimum wages affect a series of outcomes, most of which are reported at the facility level (f). The main exceptions are county (c) based measures of mortality and QWI-based employment. Denoting the level of observation $x \in \{c, f\}$ as either the county or facility, for each outcome y_{xpt} in facility or county x, in county border pair p at time t, I estimate

$$y_{xpt} = \beta log(MW)_{xpt} + X'_{xpt}\phi + \gamma_x + \gamma_{pt} + \varepsilon_{xst} \quad (1)$$

where $log(MW)_{xpt}$ is the prevailing real minimum wage in the county or facility so that the coefficient of interest, β, indicates the effect of a 100 log point increase in the minimum wage.[13] X'_{xpt} is a vector of controls for the population age structure and business cycle conditions – including the county unemployment rate, state income assistance and tax policies – in order to account for factors that may affect changes in minimum wages, elderly health, or nursing home staffing.[14] I also present results with and without demographic controls for nursing home resident race, gender, and payment source in order to examine whether observed changes are exclusively driven by changes in resident composition. γ_x is a geographic fixed effect for the county or facility that absorbs all time-invariant characteristics. γ_{pt} is a time fixed effect specific to each county pair that flexibly accounts for features that evolve over time within two neighboring counties, including labor market conditions and changes in the share of residents requiring long-term care.[15] The inclusion of γ_{pt} therefore limits all comparisons to facilities in neighboring jurisdictions – facilities that tend to be more similar than those in non-neighboring areas (Table 1).

The pair-specific time fixed effect, γ_{pt}, flexibly captures local dynamics within a pair, but

[13]For county-level analyses when some cities have local minimums, I define the minimum wage as the highest minimum in the county. Less than 4% of the sample includes city-level reforms; results are robust to using the average minimum wage in these counties.

[14]Results are robust to omitting all demographic and policy covariates. At the state level, the share of Medicaid expenditures on home-based and community services and the average Medicaid reimbursement rate is also not associated with changes in the minimum wage.

[15]Standard errors are clustered at the county level.

this term is not identified for counties that do not straddle a policy discontinuity. Therefore, while the CBCP-TWFE approach may have advantages in internal validity, whether these results generalize to all counties is less clear, even though average characteristics of the CBCP sample are similar to those of the national sample (Appendix Table A3). Appendix A presents results under a state-by-year TWFE framework leveraging minimum wage variation across all facilities and counties and comparing outcomes within a Census Division with Division-by-time fixed effects, γ_{dt}, in order to balance considerations of external validity, while partially accounting for regional heterogeneity (Allegretto et al., 2017):

$$y_{xdst} = \beta log(MW)_{xdst} + X'_{xdst}\phi + \gamma_x + \gamma_{dt} + \varepsilon_{xdst} \quad (2)$$

Results are largely robust to the Census Division TWFE approach, indicating the findings are not due to the unique experiences of border counties and suggesting that cross-border spillovers within narrow geographic areas do not drive the main results.[16]

4 Results

4.1 Workers

Earnings and employment Although U.S. nursing homes are a large low-wage employer, there is little research examining how minimum wages affect this industry.[17] All else equal, higher wages increase the opportunity cost of unemployment, incentivizing workers to improve performance in order to maintain employment. In addition to a pure effort channel, higher wages could improve performance by alleviating financial stress and reducing cognitive loads (Mani et al., 2013). Finally, higher wages increase retention by lowering the arrival rate of better paying job offers. While greater effort, reduced cognitive burdens, and increased firm-specific human capital are predicted to improve the quality of care consumers receive, higher minimum wages also increase firms' labor costs. Therefore, employers may reduce staffing, leading to worsened quality of care. The net effect on consumer well-being

[16]Results are also robust to comparing facilities within a Hospital Referral Region (HRR) (Appendix Table A10, A11, and A13).

[17]Other work documents the role of minimum wages in the UK nursing home market, see for example, Giupponi and Machin (2018), Draca et al. (2011), and Machin et al. (2003).

is ambiguous and depends on the magnitude of the quality and quantity channels.

Table 2 examines how higher minimum wages affect low-wage nursing home employees' earnings using data from the QWI, OSHPD, CPS, and ACS described in Section 3. Column 1 reports an earnings elasticity with respect to the minimum wage among female high school-educated nursing home staff of 0.12 using the county-quarterly measure of average earnings from the QWI and the county-level CBCP-TWFE framework in Equation 1. This estimate is similar to the estimated elasticity among nursing assistants (column 2) using facility-level data for the set of California local reforms. Columns 3-5 report results using the household surveys. Since granular geographic information is not available for every respondent, each column reports results using the framework in Equation 2, where the geographic fixed effect γ_x is at the state level for CPS analyses and at the PUMA level for the ACS analyses, and the time fixed effect γ_{pt} is Census Division-specific in order to restrict comparisons to workers in a single Division. Across all specifications and datasets, a 10% increase in the minimum wages increases nursing assistants' earnings by 1.1-3.4%. Appendix Table A4 examines earning responses among higher-wage nursing staff and shows some slight reductions in LPN pay only in the CPS analysis. Importantly, the lack of earnings gains for credentialed staff indicates the results in Table 2 are not simply capturing economy-wide wage increases.

Table 3 reports corresponding employment elasticities and shows no significant reduction in low-wage employment in either the county-quarterly QWI data (column 1) or OSCAR/CASPER payroll data (columns 2-7). If anything, columns 4-7 suggest a slight increase in the number of full-time equivalent nursing assistants, driven by workers who typically work fewer than 35 hours a week.[18] In addition, there is no significant shift towards higher-wage nursing staff (Appendix Table A5). The shift towards part-time workers could reflect employers responding to higher wage rates by reducing expenditures on non-wage compensation (Clemens, 2021). Available data lack comprehensive compensation information, but many elements of non-wage benefits vary by full- and part-time status. For example, part-time

[18]Part-time is defined as usually working fewer than 35 hours a week; therefore, the full/part-time distinction does not capture all intensive margin responses.

nursing assistants have lower access to employer-sponsored health insurance than full-time staff and conditional on access, lower participation rates (CDC, 2004). Although speculative, the results in Table 3 are consistent with employers shifting towards workers that require lower total compensation. Altogether, the lack of a significant disemployment effect among nursing assistants is consistent with findings in other low-wage sectors (Belman and Wolfson, 2014; Doucouliagos and Stanley, 2009) and predicts improvements in care when the minimum wage increases.[19]

Employee retention and turnover Both employment levels and flows may affect service quality. Increased retention is expected to benefit residents by improving the continuity of care and benefit firms by lowering hiring and training costs. Empirically, high turnover in nursing homes is associated with poor patient health and more inspection violations (Castle et al., 2007; Gandhi et al., 2021; Antwi and Bowblis, 2018).

Table 4 examines how turnover among low-wage employees changes in response to minimum wages using data from the QWI and OSPHD.[20] Quarterly turnover does not significantly change at the county level, measured with the QWI (column 1). Column 2 indicates a 10% increase in the minimum wage reduces annual turnover among nursing assistants in California facilities by about 3%, larger and more precisely estimated than the results in column 1.[21] Columns 3 and 4 disaggregate quarterly separations into stable hires – new hires who remain with the same employer for at least 3 months and separations, respectively. While stable hires increase, separations fall by a magnitude similar to that found among teenagers

[19]Appendix Figure A2 shows nursing home earnings and employment responses are comparable to other low-pay settings in the existing literature. Appendix Table A6 shows results are not sensitive to the CBCP-TWFE approach.

[20]Appendix Table A7 shows corresponding results for college-educated workers.

[21]The quarterly turnover rate for these California counties over the 2003-17 period is about 22% lower than for the national sample over the full 2000-17 period in the QWI data. The larger reduction in California counties could indicate differences in substate vs. state and federal reforms or cross-state differences in the responsiveness of worker retention. The QWI analyses lack sufficient statistical power to fully distinguish among these explanations.

and restaurant workers (Dube et al., 2016; Portugal and Cardoso, 2006; Brochu and Green, 2013). Broadly, these patterns are consistent with dynamic monopsony models where higher wages enable firms to fill vacancies and increase worker retention.

Worker types Higher potential earnings could enhance productivity by increasing worker effort or prompting new workers to enter the labor market (Shapiro and Stiglitz, 1984). Appendix Table A8 disentangles these channels by examining whether higher wages change the demographic characteristics of nursing assistants and shows no economically or statistically significant change in nativity, race/ethnicity, gender, educational attainment, or household characteristics. These null effects, combined with the turnover results in Table 4 indicate that changes in patient outcomes are more likely due to enhanced firm-specific human capital or performance, rather than the types of people employed in healthcare support occupations.

4.2 Consumers

Since higher minimum wages increase nursing assistant earnings, reduce turnover, and do not significantly reduce employment or change worker characteristics, service quality is expected to improve. Unlike most industries where the lack of objective quality measures presents an empirical challenge for examining this relationship, several dimensions of quality are systematically reported for nursing homes.

4.2.1 Patient safety

Federally-required annual health inspection reports measure patient safety and the suitability of the living environment. Table 5 shows how higher wages affect the number and severity of "quality of care" violations – infractions that are most closely associated with nursing care. Column 1 shows that higher wages reduce violations: a 10% minimum wage increase reduces the likelihood a facility has any quality of care violation by 0.6 percentage points (0.7%) and the number of such violations by about 0.08 (2%). These overall improvements, measured as improvements in the violation index, are driven by minor infractions: there is no significant change in prevalence and number of severe violations.[22]

[22]Results for all violations indicate a smaller reduction in total violations and a worsening of severe violations, indicating any improvements are driven by conditions related to nursing

These findings provide some of the first empirical evidence on how higher wages affect service provision in the US context. In a working paper, Giupponi and Machin (2018) examine a similar outcome in the context of a national minimum wage increase in the UK and find inspection reports worsened when the minimum wage rose. The different findings in the US and UK suggest that other institutions may shape this relationship. One such candidate is difference in rating systems: British inspectors rate each facility on 5 summary metrics, whereas US inspectors quantify the number of violations in more than 200 categories and include infractions that are not severely presenting active risks. Another possibility is differences in the ability to adjust prices when labor costs rise. British firms cannot alter their fees in response to staffing costs, whereas US firms are more able to adjust revenue even though a large share of revenue is determined through Medicare and Medicaid schedules. For example, about 2/3 of states incorporate staffing costs in their Medicaid reimbursement schedules and firms can offset higher labor costs by charging private-paying consumers higher prices. Section 4.4 examines this hypothesis directly and finds evidence that other outcomes – patient health and mortality – improve in facilities that are most able to adjust revenue.[23]

More generally, the negative relationship between worker wages and inspection violations is consistent with other work showing that greater staffing resources improve patient safety. The results in Table 5 suggest higher minimum wages are at least as cost efficient as non-wage strategies to increase staffing, and are comparable to modest increases in employee retention. For example, a 10% minimum wage increase is similar to increasing nursing assistant care by an hour per resident (44%) (Bowblis and Roberts, 2020; Harrington et al., 2000), a 1 percentage point reduction in nursing staff turnover (Antwi and Bowblis, 2018), a 4 percentage point increase in the unemployment rate (Huang and Bowblis, 2018), or about

care (Appendix Table A9).

[23]In addition, the one-year period surrounding a national-level minimum wage reform in Giupponi and Machin (2018) precludes fully accounting for changes in inspection routines that coincided with the minimum wage, whereas my analysis covers 20 years of reforms that affected facilities at different times.

1/3 of the safety improvements from raising Medicare rates by 20% (Konetzka et al., 2004).

4.2.2 Resident health outcomes

Inspection violations offer insights into a facility's environment but provide only indirect information on resident health. The Quality Measures from patient assessments provide direct information on adverse health conditions that are likely associated with nursing care, such as pressure ulcers, urinary tract infections, physical restraints, and psychotropic medications.

Moderate-to-severe pressure ulcers, although largely preventable with routine mobility and monitoring, affect more than 8% of nursing home residents. Since nursing assistants help residents with mobility and monitor patient health, better care is expected to reduce the prevalence of pressure ulcers. Consistent with this hypothesis, Table 6 column 1 shows that raising the minimum wage by 10% reduces the share of residents with pressure ulcers by 0.14 percentage points, about 1,900 fewer cases each quarter. This result is robust to including resident demographic characteristics, indicating that the reduction is not due to facilities admitting more low-risk patients (column 2).

UTIs are the most common bacterial-related cause of hospitalization among long-term care residents, and are commonly caused by indwelling catheters. Nursing assistants administer and monitor these devices, and can affect the prevalence of UTIs by promptly removing catheters or reducing their use (CDC, 2009; ONET, 2018). Columns 3-4 show that higher minimum wages do not significantly change the share of residents with infections, but point estimates suggest a small reduction.

Nursing homes may also adjust the use of physical restraints in response to higher labor costs but the direction of this relationship is ambiguous. If restraints require staff attention or assembly, higher wages may increase the use of such devices (Grabowski et al., 2011), but by restricting movement, greater nursing resources should reduce the use of these devices (Cawley et al., 2006). Columns 5-6 shows a weak negative relationship between minimum wages and physical restraints, consistent with other work finding more nursing resources and additional staff reduce restraint use (Cawley et al., 2006; Grabowski et al., 2011).

Higher-quality care is also expected to reduce the fraction of residents receiving psy-

chotropic medications, sedating drugs that affect cognition and behavior. While previous work has found additional licensed nurses are associated with lower anti-psychotic use (Grabowski et al., 2011), columns 7-8 indicate that higher minimum wages do not reduce the use of psychotropic medications, and point estimates suggest a meaningful increase.

Finally, columns 9-10 combine pressure ulcers, UTIs, and physical restraints in a standardized "poor health" index, where a value of 1 indicates health worsens by one standard deviation. This summary measure indicates a 10% minimum wage increase improves patient health by 0.02 standard deviations.

These results indicate that modest minimum wage increases yield meaningful improvements in health conditions that result from nursing care. As pressure ulcers are largely preventable, but expensive to treat, much of the existing work has focused on this outcome. Comparing the results in Table 6 with the previous literature indicates higher minimum wages improve health somewhat more than other policies. For example, staffing requirements and unionization have no effect on pressure sores prevalence (Matsudaira, 2014; Sojourner et al., 2015), and a 10% increase in the minimum wage is approximately equivalent to a more extreme reform that doubles RN care (Konetzka et al., 2008; Dorr et al., 2005). The reductions in pressure ulcers from higher wages are also sizable relative to improvements stemming from business cycle fluctuations. For example, a 10% minimum wage increase is comparable to a 1.2 percentage point increase in the local unemployment rate (Huang and Bowblis, 2018) or a 2.6 percentage point (3-4%) reduction in worker turnover (Antwi and Bowblis, 2018).

4.2.3 Mortality

Nursing home resident mortality complements the previous analyses by considering an outcome that is not prone to inspector oversight or assessment measurement error. In addition, mortality is an unambiguous measure of health that captures dimensions of resident well-being not accounted for by pressure ulcers, violations, or infections.[24] Previous work has shown that higher staffing levels reduce nursing home mortality (Stevens et al., 2015), but

[24]The combination of violations, pressure ulcers, and UTIs predicts about 7% of the variation in nursing home mortality.

there is limited evidence on how wage policies affect resident longevity.

Table 7 examines the relationship between higher minimum wages and the age-adjusted elderly mortality rate by place of death. A 10% increase in the minimum wage reduces overall mortality by 0.7% (column 1), or 0.5% accounting for demographic changes in nursing home residents (column 2). This overall increase in longevity is driven by lower mortality in nursing homes. A 10% increase in the minimum wage reduces deaths in nursing homes by 3.2%, or 3.1% controlling for changes in resident demographics (columns 3-4). These estimates suggest that an across-the-board 10% increase in each county's minimum wage would have prevented approximately 15,000 deaths in 2013. Higher minimum wages also reduce mortality among the eldest nursing home residents – those ages 75+ or 85+ for whom selection into nursing homes is less of a concern than for younger residents (Appendix Table A12).[25] In contrast, there is no significant relationship between minimum wages and elderly mortality rates outside of nursing homes (columns 5-6), including deaths in hospitals that may occur when residents are transferred from facilities to hospitals (columns 7-8).

Accounting for the modest costs of minimum wage increases, these mortality reductions are somewhat larger than the estimated effects of other changes in the nursing home workforce. For example, a 10% minimum wage increase (a 1-2% increase in nursing assistant pay) generates improvements similar to a 6.4% increase in staffing (Tong, 2011) or a 0.66 percentage point increase in the unemployment rate (Stevens et al., 2015). Put another way, the 2007-09 increase in the federal minimum wage had approximately half the effect on elderly mortality as the change in unemployment during the Great Recession.

4.3 Dynamic responses

The TWFE analyses show the contemporaneous effect of minimum wage increases. If safety measures take time to implement or health outcomes indicate routine patterns of care, the longer-term effect will be larger than the immediate effect (Goodman-Bacon, 2021). On the other hand, the TWFE approach misses any anticipation effects that arise if firms adjust

[25] Appendix Table A12 also shows a decrease in the facility-level mortality rate among California facilities (column 1).

wage schedules before the implementation date. More generally, a causal interpretation of the TWFE results requires that within a county pair, minimum wage timing is uncorrelated with factors affecting elderly health, conditional on covariates. Event study analyses can shed light on the plausibility of the parallel trends identifying assumption within a county pair and illustrate the treatment effect dynamics.

Minimum wages frequently change in both counties within each county pair. Therefore, to fix a "pre-treatment" period, the event study sample focuses on reforms that increase the within-pair minimum wage gap by at least 5 log points and do not follow another change that is greater than 0.5 log points in the pre-treatment period. These events are the starkest changes from the status quo and represent 5-8% of all reforms (Appendix Figure A3 shows the included reforms).[26] Events are stacked and scaled by the change in the log wage gap to account for reforms of different sizes, similar to the approach in Finkelstein et al. (2016). Specifically, for outcome y_{xpt} in $x \in \{c, f\}$ at time t, the event studies estimate:

$$y_{xpt} = \sum_{j=-16}^{16} \kappa_i \mathbb{1}\{\gamma_{xt} = j\} * \mathbb{1}\{\Delta log(MW)_{cpj=0} > \Delta log(MW)_{(-c)pj=0}\} * \\ \left(\Delta log(MW)_{cpj=0} - \Delta log(MW)_{(-c)pj=0}\right) + X_{xpt}^{'}\phi + \gamma_{pt} + \gamma_x + \gamma_{j=0} + \varepsilon_{xpt} \quad (3)$$

where $\mathbb{1}\{\gamma_{xt} = j\}$ is an indicator function for each quarter in event time j, interacted with an indicator for the "treatment" facilities ($\mathbb{1}\{\Delta log(MW)_{cpj=0} > \Delta log(MW)_{(-c)pj=0}\}$) in which the minimum wage increased more than the neighboring county, and scaled by the within-pair log wage gap change $\left(\Delta log(MW)_{cpj=0} - \Delta log(MW)_{(-c)pj=0}\right)$. $X_{xpt}^{'}$, γ_{pt}, and γ_x are defined as in the TWFE specification (Equation 1).

Figure 2 presents event study plots showing how the number of quality of care violations (panel a), the prevalence of pressure ulcers (b) and UTIs (c), and nursing home mortality (d) evolve following minimum wage reforms with the solid line showing results from a linear

[26] As is standard in the minimum wage literature, placing restrictions on the preceding period without minimum wage changes is necessary in order to plot pre-trends (e.g. Cengiz et al. (2019)). Relying on a longer pre-treatment period or a different within-pair gap threshold yields qualitatively similar short-term results. The sample of minimum wage reforms varies across outcomes due to the years covered in the data.

spline with kink points every 4 quarters. Appendix Figures A5-A6 show corresponding analyses for annual employment patterns and resident demographics.

Crucially, Figure 2 shows pre-reform trends are economically and statistically insignificant across all outcomes, indicating that the TWFE estimates do not simply reflect correlations between longer-term trends in elderly health and prevailing wages. Point estimates suggest violations fall 2-4 quarters after a higher minimum wage is implemented (panel a), but confidence intervals cannot rule out a null effect. The effect is more pronounced, immediate, and persistent for pressure ulcers (b), whereas the reduction in UTIs is concentrated about 2 quarters after the wage becomes effective (c). Finally, mortality begins to decrease about 4-5 quarters after the wage hike and persists over the following 3 years, both for the full elderly population (d) and the eldest individuals (Appendix Figure A4). These improvements in relative conditions in areas experiencing a wage increase are not due to deteriorating conditions in neighboring counties: the event time coefficients for the "control" jurisdictions are small in magnitude and statistically insignificant before and after the wage gap increases.

The timing of patient health changes is consistent with how each outcome develops: inspection citations may reflect longer-standing environmental features, UTIs and pressure sores develop within days or months, whereas cumulative health drives mortality. Appendix Figure A5 explores whether these dynamics track employment patterns and shows no significant change in nursing assistant staffing 4 years before through 5 years after a wage increase. Together, these patterns suggest that the health improvements observed in Figure 2 are not driven by greater direct care staff time or substitution towards licensed nursing staff.

4.4 Patient composition

The main TWFE specifications control for resident demographics in order to avoid confounding changes in patient outcomes with underlying risk factors. Although results are similar when excluding these controls, any change in the types of individuals that have access to long-term care has social welfare implications.

The revenue structure of nursing homes suggests that increases in the minimum wage may incentivize firms to change resident composition since residents who pay from their own

resources typically pay higher prices than those with insurance coverage through Medicaid.[27] Although facilities cannot legally discriminate based on payment source, they can turn away patients with care needs they cannot meet. Therefore, when demand among private payors increases or occupancy approaches capacity, facilities have incentives to discharge Medicaid recipients or selectively admit residents in order to increase revenue (Gandhi, 2020; Hackmann and Pohl, 2018).[28] In a similar spirit, facilities could increase transfers to hospitals in order to receive Medicare rates when patients are readmitted to the facility. However, Table 8 columns 1-3 show no economically or statistically significant change in discharge, occupancy, or hospital admission rates. These patterns are consistent with the legal environment and inconsistent with "churning" patients to maximize revenue.

Facilities nonetheless have ample scope to adjust their resident mix without changing discharge practices as more than one-third of nursing home beds open each year due to either death or discharge. Table 8 shows higher minimum wages shift resident composition towards higher-revenue residents: a 10% minimum wage increase reduces the share of Medicaid residents by 0.5% (0.23 percentage points, column 4), increases the share of private payors by a similar amount (column 5) and slightly increases the Medicare share (column 6). Appendix Figure A6 illustrates this compositional shift in the Medicaid share occurs 2-3 years after the wage increase, timing that is consistent with firms shifting admissions, rather than discharging current residents.

Facilities may also increase revenue on the intensive margin from Medicare and private payors by determining these residents require greater services. Evidence on this margin is somewhat mixed. Although facilities report higher average care needs among all residents (Table 8, columns 7-8),[29] these shifts are not driven by changes in revenue per Medicare

[27]Stays financed by Medicare that yield revenue that is generally higher than Medicaid, but limited to 100 days.

[28]The number of Medicaid and Medicare residents is capped at the number of beds that are certified by CMS, but a certified bed can also be occupied by a private payor. All beds are certified in more than 94% of facilities.

[29]These indices are computed from the number of ADLs residents require assistance with

beneficiary (columns 9-10).

Appendix Table A14 examines other resident characteristics that might be correlated with health outcomes. Columns 1-6 report objective characteristics; columns 7-11 show care needs that may be affected by assessor judgment. Results are mixed for both sets of characteristics. On some dimensions, higher minimum wages lead to advantageous selection, with fewer residents experiencing obesity, hypertension, or difficulty walking. By other measures – schizophrenia and incontinence – higher minimum wages increase the care need mix.

Two bounding exercises explore whether these changes in patient composition can explain improved health and safety. First, I define predicted outcomes $\widehat{y_{xt}}$ as predicted values from all two-way interactions of patient characteristics and replace actual health and safety outcomes in the main analysis with these predicted values. Appendix Table A15 odd-numbered columns show predicted changes due only to objective characteristics (Appendix Table A14, columns 1-6). Even-numbered columns show predicted changes based on all resident characteristics in Appendix Table A14 and ADL needs from Table 8. The row "% main effect from" indicates changes in objective patient demographics account for 11% of the observed reduction in health inspection violations (column 1), 0% of pressure ulcer prevalence (column 3), and would predict increased mortality rates (column 5). Incorporating the more subjective characteristics suggests patient composition does not explain most of the improvements in violations, pressure ulcers, or mortality.

Second, overall elderly mortality is a lower bound on the effect of higher minimum wages on mortality among the nursing home-eligible population (Table 7, column 1). By this estimate, a 10% increase in the minimum wage reduces the overall elderly mortality rate by 0.5-0.7%, about 16-21% of the reduction of nursing home deaths. Since elderly mortality outside of nursing homes does not increase (columns 5-8), higher minimum wages do not worsen outcomes for those outside nursing facilities, at least on this margin.

(column 7) or ADLs plus therapeutic and rehabilitative services (column 8).

4.5 Heterogeneity and robustness

The local market structure and provider type may determine how higher wages affect staffing and performance. Appendix Tables A16-A17 explore whether average effects mask heterogeneous responses by interacting the minimum wage with whether an establishment has an above-average Medicaid share, if it is privately owned, part of a multi-establishment chain, in a competitive industry, in a state with a minimum staffing requirement, or in a state where Medicaid reimbursement formulas incorporate labor costs. Employment tends to increase in privately-owned and non-chain facilities, as well as those with wage reimbursement provisions in Medicaid formulas (Appendix Table A16). While improvements in patient outcomes generally do not systematically vary with facility characteristics, the improvements in pressure ulcer incidence and mortality are larger in states where Medicaid reimbursement schedules incorporate labor costs that enable facilities to pass some wage costs through to government payors (Appendix Table A17).

The CBCP-TWFE design leverages wage differences between neighboring counties in order to isolate wage variation that is orthogonal to local labor market conditions. Appendix Tables A10, A11, and A13 include results for nursing homes in all counties, including facilities in interior counties, with state and Census division-by-time fixed effects (Equation 2) as well as variation within a Hospital Referral Region (HRR) in order to allay concerns that the main results are sensitive to the county-pair design or sample.[30] All results are qualitatively robust to these alternative approaches, as well as specifications that analyze the CBCP-TWFE approach on county pairs in the same state that experienced substate reforms in order to account for all unobserved changes in state-level policies.

A separate concern with the county-pair design is that higher minimum wages may spill over to neighboring counties. The direction and magnitude of such SUTVA violations from cross-border spillovers is *a priori* ambiguous (Dube et al., 2010) and can be gleaned by comparing outcomes in facilities located in border counties to those in a state's interior. There

[30]The HRR sample includes more rural and midwestern counties than the county-pair sample (Appendix Figure A7).

is no consistent pattern of within-state differences between border and interior counties: interior counties have larger reductions in pressure ulcers, but border counties have greater drops in mortality, and the differences in UTIs and violations are not statistically significant. These mixed results suggest that cross-border spillovers are limited in this setting.

Robustness checks show patient safety and health outcomes are qualitatively unchanged with sample modifications, including extreme values, unweighted specifications, and omitting facilities located in hospitals (Appendix Tables A10-A11). In addition, using false-discovery rate sharpened q-values (Anderson, 2008) rather than conventional p-values continues to yield significant reductions in violations, ulcers, restraints, and nursing home mortality.

One potential confounding factor is that higher labor costs may cause low-performing firms to exit the market. As closed facilities do not report outcomes, high exit rates would overstate the aggregate benefits of higher minimum wages. Appendix Figure A8 displays an event study plot on all facilities that operate at any point between 1991-2017, where the dependent variable equals one if the facility operated each year. There is no significant patterns in industry growth before or after a wage increase, indicating that higher minimum wages do not lead firms to exit the market.

4.6 Firm costs, revenue, and profitability

Table 9 shows how firms' costs and revenue change after a minimum wage increase using annual financial data for the subset of facilities that serve Medicare recipients. Higher minimum wages increase costs per resident by about 70-90% of the mechanical labor cost increase from nursing assistant wages alone, or 97-98% of the wage increase for all low-wage workers (nursing assistants plus maintenance and food preparation staff, column 1). Column 2 indicates firms fully offset these costs by generating greater revenue: a 10% increase in the minimum wage increases revenue per resident by 0.7%, slightly more than the estimated costs in column 1. Accordingly, net income does not significantly change (column 3).[31]

Per-resident revenue can change with either patient composition or amounts received

[31]Net income is total revenue – including ancillary, outpatient, and clinical services – minus total costs.

from each payor type. A 10% minimum wage hike increases the fraction of private payors by about 0.25 percentage points (1%), but there is no significant change in per-resident revenue among Medicare recipients at the firm level (Table 8, columns 9-10) or Medicaid recipients at the state level (Table 9, column 4).[32] A back-of-the-envelope decomposition indicates on average, approximately 75% of the increase in per-resident revenue is due to higher prices paid by private payors, and 25% is due to facilities serving fewer Medicaid recipients. For a 100-bed facility initially serving the average share (60) of Medicaid residents and 15 private payors, these estimates imply that a 10% minimum wage increase would reduce the number of Medicaid recipients by 0.3 and increase prices for private payors by about $5.90 a day.

Table 9 shows that on average, firms are not strictly worse or better off paying higher wages following modest minimum wage increases. Nonetheless, the ability to re-coup higher labor costs by increasing consumer prices raises the question of why firms do not unilaterally increase wages in order to improve services. With imperfect information in either the labor or the service market, it can be rational for firms to pay low wages and offer relatively low-quality care. Asymmetric information on wages may arise because of applicants' search costs or perceptions that the industry offers low wages. A higher guaranteed wage could induce workers to enter the nursing home labor market, which in turn could reduce the firm's hiring costs. In the product market, even if wages perfectly reflect quality, it is unclear if prospective residents know or are able to act on facility-specific information, which limits any potential benefit from firm-specific wage increases. In contrast, if all firms increase wages, consumers may expect quality at *any* facility in an area has improved even if they cannot discern a particular firm's quality, thereby increasing market-level demand for nursing home care. Thus, economy-wide wage reforms may be necessary to trigger a demand response that

[32]Facility-level Medicaid payments are not systematically collected across states over time and this measure does not capture changes in which residents "spend down" their assets in order to quality for Medicaid. Information from California, which has cost-based Medicaid reimbursements, indicates that higher minimum wages increase per-resident revenue from both Medicaid and private payors without increasing revenue from Medicare residents.

allows firms to operate without lowering profitability.

5 Conclusion

This paper finds that higher wages for workers translates to better service quality, measured by improved safety, better health, and reduced mortality for nursing home residents. These benefits are both statistically significant and economically meaningful. Applying the average pressure sore treatment costs from the previous literature (Agency for Healthcare Research & Quality, 2016; Brem et al., 2010) to the point estimates in Table 6 and the estimated increase in nursing assistant pay suggests that cost savings from pressure sore treatment alone offset between 20-50% of the increase in staff costs. This simple back-of-the-envelope calculation implies that wage increases in the nursing home sector fully pay for themselves if the value of increased longevity for nursing home residents is at least $23,000.[33]

Accounting for improved service quality enhances the desirability of minimum wages, but the introduction of a quality margin does not necessarily mean minimum wages are socially beneficial. Appendix C demonstrates that the social benefits of higher minimum wages are increasing in the welfare weights of consumers and low-income workers, the ratio of Medicaid recipients to taxpayers, and the responsiveness of service quality to employee wages.

The results documented in this paper show that higher minimum wages can improve consumer well-being. While these findings are consistent with recent work documenting that higher minimum wages increase retail worker productivity without lowering profits (Coviello et al., 2018), several points are critical when extrapolating to the broader economy. First, restrictions on the supply of nursing home services and operating regulations create entry costs that stifle competition in both the labor and product markets. Second, there are few close substitutes for nursing home care. Therefore, while profits and employment do not significantly fall in the nursing home industry, these results may not apply to industries facing greater competitive pressures. With these caveats in mind, the results are of policy interest in their own right. Governments are major actors in health care provision and

[33] $23,000 is well below estimates in Murphy and Topel (2006) and Hall and Jones (2007), as well as willingness to pay measured by annual costs of residential care.

financing. These costs will increase as the population ages, and the potential to increase longevity and reduce expenditures on preventable medical care through policies that benefit workers in this industry has important social welfare and fiscal implications.

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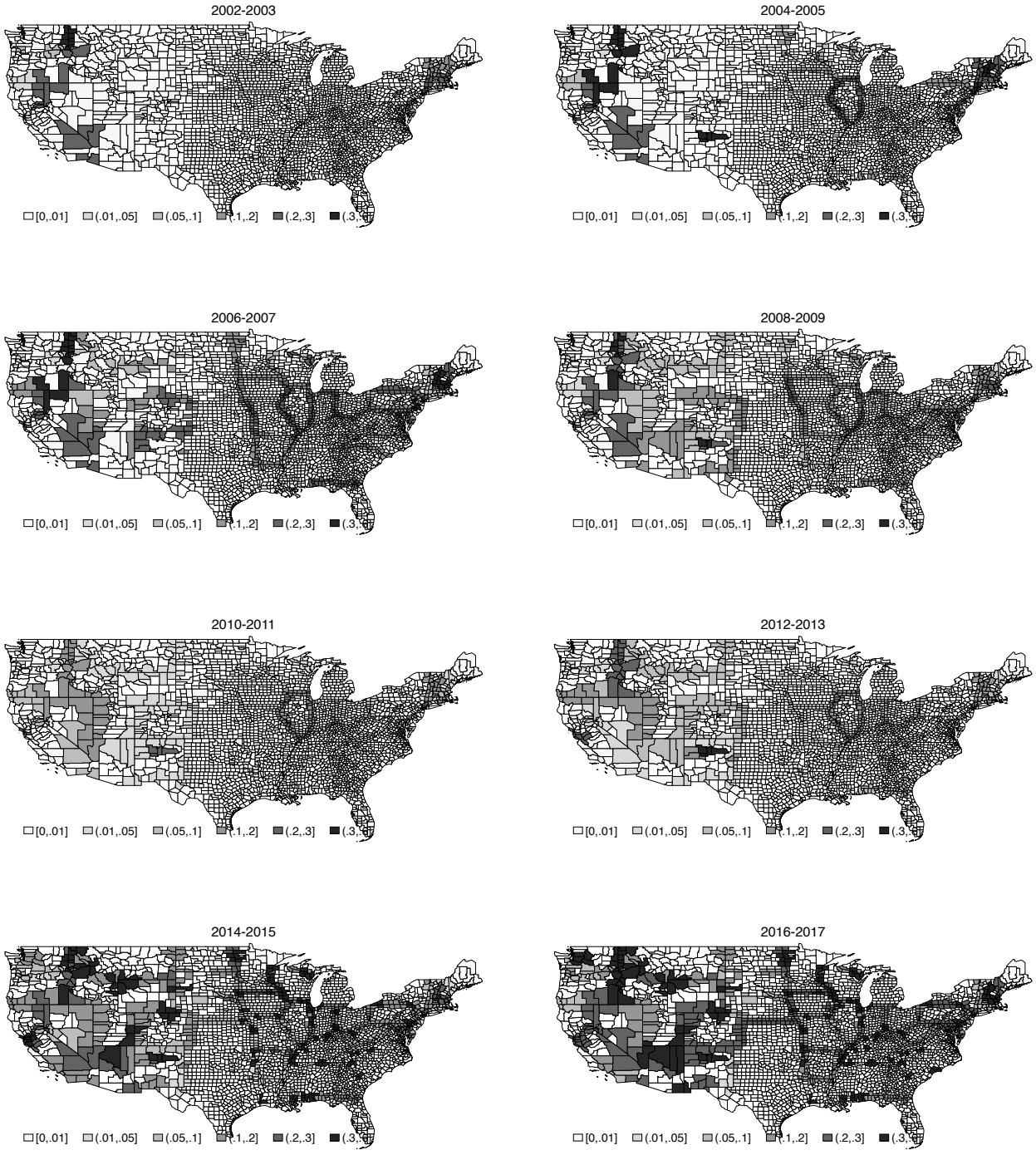
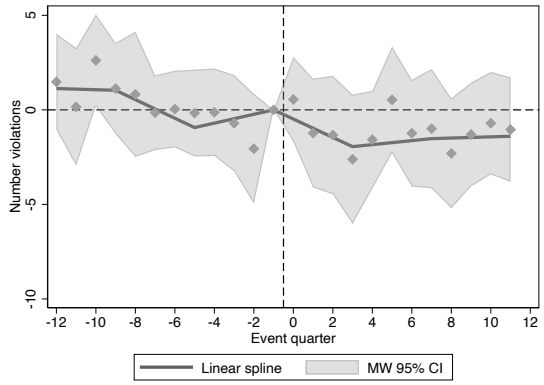
Figure 1: County Pair Log Minimum Wage Differential, by Year



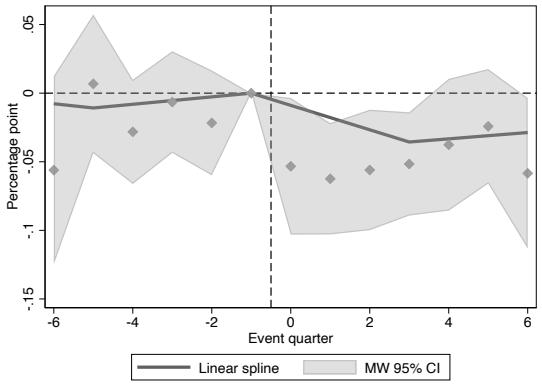
Notes: Figure shows the maximum difference in inflation-adjusted log minimum wages between adjacent counties for each two year period in which there is at least one nursing facility in each county.

Figure 2: Event Studies, Patient Outcomes

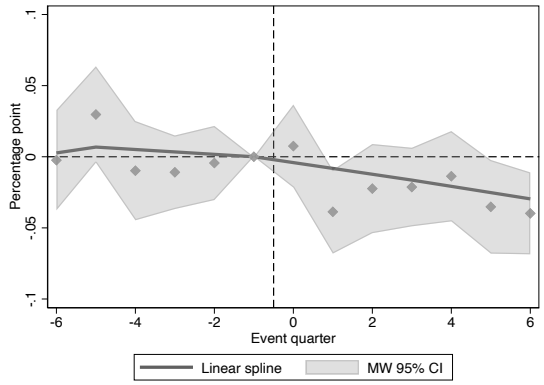
(a) Quality of care violations



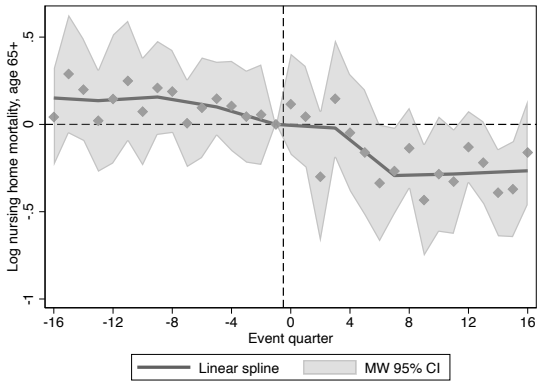
(b) Pressure ulcers



(c) UTIs



(d) Nursing home mortality



Notes: Figure shows event studies under the specification in Equation 3. Red circles show the change in the number of quality of care violations (panel a); prevalence of pressure ulcers (b), UTIs (c); and log mortality rate (d). Sample is limited to reforms that changed the within-county-pair log gap by at least 5 log points and for which there were no changes greater than 0.5 log points in the preceding 10 (panel a), 6 (b-c), or 16 (d) quarters. Solid line shows trends for a linear spline with each segment 4 quarters in length. All specifications include controls for county employment rates and the elderly population share; state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels; and county-pair-quarter and reform period fixed effects. Panels a-c include facility fixed effects; panel d includes county fixed effects. Shaded areas indicate 95 percent confidence intervals with robust standard errors clustered at the county level. P-value of test all pre-reform coefficients for patient outcomes equal zero is: 0.879 (panel a); 0.212 (panel b); 0.634 (panel c); and 0.224 (panel d). Data from OSCAR/CASPER 1998-2017 (panel a) 2005-2017 (panels b-c) and Vital Statistics 1990-2013.

Table 1: Nursing Home and Area Characteristics, Differences between County Pairs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Level				4-quarter change				12-quarter change			
	Random county	County pair	Gap $(2-1)$	%age gap $(3/2)$	Random county	County pair	Gap $(6-5)$	%age gap $(7/6)$	Random county	County pair	Gap $(10-9)$	%age gap $(11/10)$
% Medicare	0.102***	0.091***	0.011***	12.1	0.067***	0.065***	0.002*	3.1	0.083***	0.082***	0.002	2.4
	(0.002)	(0.002)	(0.002)		(0.001)	(0.001)	(0.001)		(0.001)	(0.002)	(0.002)	
% Medicaid	0.166***	0.141***	0.025***	17.7	0.090***	0.087***	0.003***	3.5	0.116***	0.112***	0.005***	4.5
	(0.002)	(0.003)	(0.002)		(0.001)	(0.001)	(0.001)		(0.001)	(0.002)	(0.001)	
% private pay	0.149***	0.108***	0.041***	38.0	0.076***	0.074***	0.002*	2.7	0.095***	0.092***	0.003***	3.3
	(0.002)	(0.002)	(0.002)		(0.001)	(0.001)	(0.001)		(0.001)	(0.002)	(0.001)	
% white	0.160***	0.085***	0.076***	89.4	0.041***	0.038***	0.003***	7.9	0.056***	0.052***	0.005***	9.6
	(0.004)	(0.004)	(0.003)		(0.001)	(0.001)	(0.001)		(0.001)	(0.002)	(0.001)	
% female	0.079***	0.073***	0.005***	6.9	0.052***	0.050***	0.002***	4.0	0.069***	0.066***	0.003***	4.6
	(0.001)	(0.001)	(0.001)		(0.000)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)	
% black	0.155***	0.065***	0.090***	138.5	0.027***	0.023***	0.004***	17.4	0.037***	0.030***	0.007***	23.3
	(0.005)	(0.005)	(0.004)		(0.001)	(0.002)	(0.001)		(0.001)	(0.002)	(0.001)	
HHI	1222.95***	742.62***	480.32***	64.7	215.88***	150.54***	65.34***	43.4	252.08***	170.05***	82.04***	48.2
	(31.936)	(41.991)	(30.177)		(7.249)	(9.390)	(5.687)		(8.224)	(10.781)	(6.454)	
Average age	4.166***	3.299***	0.867***	26.3	1.752***	1.692***	0.061***	3.6	2.530***	2.429***	0.101***	4.2
	(0.043)	(0.061)	(0.057)		(0.025)	(0.029)	(0.021)		(0.035)	(0.044)	(0.033)	
Unemployt rate	2.432***	1.488***	0.944***	63.4	0.894***	0.708***	0.186***	26.3	1.581***	1.113***	0.467***	42.0
	(0.033)	(0.034)	(0.034)		(0.008)	(0.013)	(0.009)		(0.016)	(0.022)	(0.017)	
Cty elderly popn share	0.044***	0.029***	0.015***	51.7	0.003***	0.002***	0.001***	50.0	0.006***	0.005***	0.002***	37.1
	(0.001)	(0.001)	(0.001)		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	

Notes: Table shows the absolute differences in each characteristic, as well as the 4- and 12-quarter changes, between each county in the CBCP sample and a randomly-assigned, non-adjacent county in a different state (columns 1, 5, and 9) or its adjacent county in the border pair (columns 2, 6, 10). Columns 3, 7, and 11 test the difference between the difference between the non-adjacent county and the border pair. Columns 4, 8, and 12 scale the results in columns 3, 7, and 11 by the contiguous pair gap. Two-way robust standard errors for each county in the comparison. Population from SEER, county unemployment from LAUS, and resident demographics from LTC Focus. *** $= p < 0.01$, ** $= p < 0.05$, * $= p < 0.10$.

Table 2: Minimum Wages and Low-Wage Employee Earnings

	(1)	(2)	(3)	(4)	(5)
	Log(quarterly earnings)	Log(annual earnings)	Log(hourly earnings)	Log(wkly earnings)	Log(annual earnings)
log(MW)	0.120***	0.113***	0.115**	0.195**	0.336**
	(0.032)	(0.018)	(0.045)	(0.077)	(0.140)
N	23058	45324	23556	23556	51234
DV mean (level)	2079.330	29361.99	12.05	448.90	20117.60
Geo FE (γ_x)	County	Facility	State	State	PUMA
Geo X time FE	Cty pair X qtr		Census Division X year		
Business cycle controls	X	X	X	X	X
Demographic controls	X	X	X	X	X
State linear trends			X	X	X
Years	2000-17	2003-17	1991-17		2000-16
Data	QWI	OSHPD	CPS-ORG		ACS

Notes: Table shows earnings elasticity with respect to the minimum wages for low-wage nursing home workers. Column 1 reports results for female employees with no more than a high school education employed in NAICS sector 6231 at the end of the quarter from the QWI. Columns 2-5 report earnings for nursing assistants working in nursing homes from OSHPD (column 2), the CPS-ORG (columns 3-4), and decennial Census and ACS (column 5). $log(MW)$ is the natural log of the highest minimum wage in county c (column 1), the local or state minimum wage (column 2), county (for those living in identifiable urban areas) or state minimum (columns 3-4) or maximum minimum wage in a PUMA (column 5) at time t, adjusted for inflation using the CPI-U-RS. "Business cycle" controls include county employment rates and the elderly population share; and state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. "Geo FE" specifies the level of geographic controls. Column 1 is weighted by county population, column 2 by the number of beds in a facility, and columns 3-5 use person weights for the respective survey. Robust standard errors clustered by county (columns 1-2), state (columns 3-4) or PUMA (column 5). *** $= p < 0.01$, ** $= p < 0.05$, * $= p < 0.10$.

Table 3: Minimum Wages and Low-Wage Employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Log ($\leq$ HS employment)	Log(nursing asst hrs/ resident day)		Log(FTE nursing asst)		Log(FT nursing asst)	Log(PT nursing asst)
log(MW)	-0.073	0.005	0.005	0.034*	0.030	0.051**	0.143***
	(0.114)	(0.017)	(0.017)	(0.021)	(0.020)	(0.022)	(0.050)
N	25424	278965	278965	438088	438088	435749	336676
DV mean (level)	955.086	2.271	2.271	37.137	37.137	31.320	7.269
Geo FE (γ_x)	County	Facility	Facility	Facility	Facility	Facility	Facility
Geo X	Cty pair	Cty pair	Cty pair	Cty pair	Cty pair	Cty pair	Cty pair
time FE	X qtr	X year	X year	X year	X year	X year	X year
Business cycle controls	X	X	X	X	X	X	X
Demographic controls	X		X		X	X	X
Years	2000-17	2000-16	2000-16	1992-17	1992-17	1992-17	1992-17
Data	QWI	OSCAR/CASPER		OSCAR/CASPER		OSCAR/CASPER	OSCAR/CASPER

Notes: Column 1 reports end of quarter NAICS sector 6231 employment for female employees with a high school education from the QWI. Columns 2-7 report staffing from the OSCAR/CASPER reports. $log(MW)$ is the natural log of the county minimum wage in year-quarter t in 2017 dollars, adjusted for inflation using the CPI-U-RS. Log hours per resident day (columns 2-3) is the number of nursing assistant staffing hours, divided by the number of residents times 24. FT employees typically work at least 35 hours/week; PT employees typically work fewer than 35 hours/ week. All specifications include county-pair-time fixed effects. Column 1 includes county fixed effects and columns 2-7 include facility fixed effects. "Business cycle" controls include county employment rates and the elderly population share; and state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. "Demographic controls" include average resident age and the share of residents female, white, black, and covered by Medicaid. Robust standard errors clustered by county. Column 1 is weighted by county population, columns 2-7 by the number of beds in a facility. *** $= p < 0.01$, ** $= p < 0.05$, * $= p < 0.10$.

Table 4: Minimum Wages and Low-Wage Worker Retention

	(1)	(2)	(3)	(4)
	Log (quarterly turnover)	Log (annual turnover)	Log(hires, employed 1+ qtr)	Log (separations)
log(MW)	-0.049	-0.265**	0.361**	-0.245*
	(0.099)	(0.109)	(0.178)	(0.140)
N	10110	43986	9150	14312
DV mean (rate)	0.199	0.449	0.111	0.196
Geo FE (γ_x)	County	Facility	County	County
Geo X time FE	Cty pair X qtr	Cty pair X yr	Cty pair X qtr	Cty pair X qtr
Business cycle controls	X	X	X	X
Years	2000-17	2003-17	2000-17	2000-17
Data	QWI	OSHPD	QWI	QWI

Notes: Table shows results for workers with a high school education or less from the QWI data at the county level (columns 1, 3-4) and for nursing assistants from the OSHPD data at the facility level (column 2). $log(MW)$ is the natural log of the highest minimum wage in county c at time t in 2017 dollars, adjusted for inflation using the CPI-U-RS. $log(turnover)$ is $log(\frac{sep+hires}{2})$ at the quarterly (column 1) or annual (column 2) rate; $log(hires, employed$ 1+ qtr) is the natural log of the hires who remained employed for at least three months; and $log(separations)$ is the natural log of the the number of workers who separated from their employer in a county-quarter cell. Specifications in columns 1, 3, and 4 include county-pair-quarter and county fixed effects; specification in column 2 includes county-pair-year and facility fixed effects. "Business cycle" controls include county employment rates and the elderly population share; and state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. All cells are weighted by county population. Robust standard errors clustered by county. *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.10$.

Table 5: Minimum Wages and Quality of Care Health Inspection Violations

	(1)	(2)	(3)	(4)	(5)
	Any	Number	Any severe	Number severe	Standardized score
log(MW)	-0.061***	-0.790***	0.030	0.051	-0.090*
	(0.021)	(0.170)	(0.020)	(0.034)	(0.051)
N	355776	355776	355776	355776	355776
DV mean	0.867	3.535	0.136	0.188	-0.026
ϵ_{mw}	-0.070	-0.223	0.221	0.271	
Geo FE (γ_x)	Facility	Facility	Facility	Facility	Facility
Cty pair X year FE	X	X	X	X	X
Business cycle controls	X	X	X	X	X
Demographic controls	X	X	X	X	X
Years	1998-17	1998-17	1998-17	1998-17	1998-17
Data	NHC	NHC	NHC	NHC	NHC

Notes: Table shows results from the state health inspection reports reported in Nursing Home Compare (NHC). $log(MW)$ is the natural log of the minimum wage at the time of the inspection in 2017 dollars, adjusted for inflation using the CPI-U-RS. "Quality of care" violations include quality of care, assessment, nursing, dietary, physician, rehabilitative services, dental, and pharmacy violations (Harrington et al., 2000). "Severe" violations are those presenting actual harm or immediate jeopardy to residents (CMS categories G-L). "Standardized score" allocates violation points to each violation based on the CMS scoring criteria and normalizes the score distribution across facilities. All specifications include county-pair-time and facility fixed effects. "Business cycle" controls include county employment rates and the elderly population share; and state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. "Demographic controls" include facility average resident age, market concentration, and the share of residents female, white, black, and covered by Medicaid. Robust standard errors clustered by county. All regressions weighted by facility size. "ϵ_{mw}" is the elasticity of the outcome with respect to the minimum wage. *** $= p < 0.01$, ** $= p < 0.05$, * $= p < 0.10$.

Table 6: Minimum Wages and Patient Health

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Pressure ulcers (share)		UTI (share)		Restraint (share)		Psychotropic (share)		Health index	
log(MW)	-0.014***	-0.014***	-0.007	-0.008	-0.008*	-0.008*	0.036	0.038	-0.199***	-0.208***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.028)	(0.028)	(0.072)	(0.071)
N	294857	294857	338662	338662	338731	338731	183081	183081	290949	290949
DV mean	0.083	0.083	0.072	0.072	0.025	0.025	0.191	0.191	-0.107	-0.107
Δ # residents (1000s), 10% increase	-1.89	-1.89	-0.94	-1.08	-1.08	-1.08	4.85	5.12		
ϵ_{mw}	-0.169	-0.169	-0.097	-0.111	-0.320	-0.320	0.186	0.199		
Geo FE (γ_x) = Facility	X	X	X	X	X	X	X	X	X	X
Cty pair X year FE	X	X	X	X	X	X	X	X	X	X
Demographic controls		X		X		X		X		X
Business cycle controls	X	X	X	X	X	X	X	X	X	X
Years	2005-17	2005-17	2005-17	2005-17	2005-17	2005-17	2011-17	2011-17	2005-17	2005-17
Data	NHC	NHC	NHC	NHC	NHC	NHC	NHC	NHC	NHC	NHC

Notes: Table shows patient outcomes from long-term resident assessment reports reported in Nursing Home Compare (NHC). $log(MW)$ is the natural log of the minimum wage in 2017 dollars, adjusted for inflation using the CPI-U-RS. All specifications include county-pair-time and facility fixed effects. "Business cycle" controls include county employment rates and the elderly population share; and state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. "Demographic controls" include facility average resident age, market concentration, and the share of residents female, white, black, and covered by Medicaid. Robust standard errors clustered by county. All regressions weighted by facility size. "ϵ_{mw}" is the elasticity of the outcome with respect to the minimum wage. "Δ # residents (1000s), 10% increase" is the estimated change in the annual number of residents for a 10 percent across-the-board minimum wage increase. *** $= p < 0.01$, ** $= p < 0.05$, * $= p < 0.10$.

Table 7: Minimum Wages and Log Elderly Mortality Rates, by Place of Death

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All		Nursing homes		Non-nursing homes		Hospitals	
log(MW)	-0.065*	-0.049*	-0.316***	-0.307***	0.000	0.017	0.053	0.053
	(0.033)	(0.029)	(0.115)	(0.110)	(0.041)	(0.039)	(0.072)	(0.070)
N	186444	186444	186888	186888	183992	183992	138802	138802
DV mean (level)	0.014	0.014	0.004	0.004	0.010	0.010	0.006	0.006
Δ # residents (1000s), 10% increase	n/a	n/a	-15.409	-14.970	n/a	n/a	n/a	n/a
Geo FE (γ_x)= County	X	X	X	X	X	X	X	X
Cty pair X qtr FE	X	X	X	X	X	X	X	X
Business cycle controls	X	X	X	X	X	X	X	X
Demographic controls		X		X		X		X
Years	1990-13	1990-13	1990-13	1990-13	1990-13	1990-13	1990-13	1990-13
Data	Vital Stats	Vital Stats	Vital Stats	Vital Stats	Vital Stats	Vital Stats	Vital Stats	Vital Stats

Notes: Table shows annual county-level age-adjusted log mortality rates for the population ages 65 and older by place of death from Vital Statistics. The age adjustment, $m_{cy} = \sum_{a=65}^{85+} \frac{deaths_{cay}}{pop_{cay}} * \frac{pop_{a,2000}}{\sum_{k=65}^{85+} pop_{k,2000}}$ holds the age composition of the population fixed at its 2000 distribution. $log(MW)$ is the natural log of the highest minimum wage in county c at time t in 2017 dollars, adjusted for inflation using the CPI-U-RS. All specifications include county-pair-quarter and county fixed effects. "Business cycle" controls include county employment rates and the elderly population share; and state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. "Demographic controls" include CZ-level market concentration and county-average resident age, and the share of residents female, white, black, and covered by Medicaid. Robust standard errors clustered by county. All regressions weighted by county elderly population. "Δ # residents (1000s), 10% increase" is the estimated change in the annual number of residents for a 10 percent across-the-board minimum wage increase. *** = $p < 0.01$, ** = $p < 0.05$, * = $p < 0.10$.

Table 8: Minimum Wages, Payment Methods, and Care Needs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Occu - pancy rate	Dis- charge rate	Hosp admit rate	Resident share			Average resident care index		Log average Medicare reimbursement	
				Medicaid	Other	Medicare	ADL	Care	1996-10	2011-17
log(MW)	0.007	-0.014	-0.007	-0.023*	0.025**	0.008*	0.178***	0.203***	-0.008	-0.020
	(0.006)	(0.010)	(0.005)	(0.012)	(0.011)	(0.005)	(0.033)	(0.029)	(0.017)	(0.016)
N	754649	287285	329665	762554	754830	755040	733993	747503	144912	96550
DV mean	0.844	0.620	0.179	0.602	0.236	0.146	0.018	0.004	333.811	458.017
ϵ_{mw}	0.009	-0.021	-0.075	-0.045	0.105	0.054				
Geo FE(γ_x) = Facility	X	X	X	X	X	X	X	X	X	X
Cty pair X year FE	X	X	X	X	X	X	X	X	X	X
Business cycle controls	X	X	X	X	X	X	X	X	X	X
Reporting period controls									X	X
Years	2000-16	2000-16	2000-16	2000-16	2000-16	2000-16	2000-16	2000-16	1996-10	2011-17
Data	LTC Focus	LTC Focus	LTC Focus	LTC Focus	LTC Focus	LTC Focus	LTC Focus	LTC Focus	HCRIS	HCRIS

Notes: Table shows resident characteristics available through LTCFocus (columns 1-8), and average reimbursement rate among Medicare residents based on RUG classification (columns 9-10) from cost reports (HCRIS). $log(MW)$ is the natural log of the minimum wage, adjusted for inflation using the CPI-U-RS. All specifications include county-pair-year and facility fixed effects. "Business cycle" controls include county employment rates and the elderly population share; and state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. "Reporting period controls" limit the sample to facilities with a reporting period that starts and ends after February of the ending year and includes controls for the reporting period start and end months; the number of beds in the facility; the days in the reporting period; and whether a reporting period was less than 11 or more than 13 months. Robust standard errors clustered by county. All regressions weighted by facility size. "ϵ_{mw}" is the elasticity of the outcome with respect to the minimum wage. *** $= p < 0.01$, ** $= p < 0.05$, * $= p < 0.10$.

Table 9: Minimum Wages and Facility Revenue and Costs

	(1)	(2)	(3)	(4)
	Log(Costs/ resident)	Log(Revenue/ resident)	IHS(Net income)	Log(Avg Mcaid per diem (state))
log(MW)	0.044*	0.070**	-1.447	-0.028
	(0.025)	(0.035)	(1.147)	(0.073)
N	286982	273936	287714	480
DV mean (level)	75109.6	91717.3	1440.6	187.93
Geo FE (γ_x)	Facility	Facility	Facility	State
Cty pair X year FE	X	X	X	
Census Division X year FE				X
State linear trends				X
Business cycle controls	X	X	X	
Reporting period controls	X	X	X	
Years	1996-17	1996-17	1996-17	2000-09
Data	HCRIS	HCRIS	HCRIS	LTCFocus

Notes: Table shows facility revenues and cost metrics from Medicare cost reports (HCRIS) (columns 1-3) and average state Medicaid reimbursement rates from LTCFocus (column 4). Sample in columns 1-3 includes facilities with a reporting period that starts and ends in January or February. $log(MW)$ is defined as the natural log of the minimum wage faced by facility f at time t in 2017 dollars, adjusted for inflation using the CPI-U-RS. Columns 1-3 include county-pair-year and facility fixed effects; column 4 includes state and Census Division-by-year fixed effects. "Business cycle" controls include area employment rates and the elderly population share; state EITC parameters, the elderly SSI receipt rate, and TANF caseloads and benefit levels. "Reporting period" controls include the starting and ending months of the cost reporting period; the number of beds in the facility; the days in the reporting period; and whether a reporting period was less than 11 or more than 13 months. Robust standard errors clustered by county (columns 1-3) or state (column 4). All specifications weighted by number of beds. *** $= p < 0.01$, ** $= p < 0.05$, * $= p < 0.10$.